# ADVANCED SYSTEMS CHECKOUT DESIGN

THIRD QUARTERLY PROGRESS REPORT
FOR PERIOD DECEMBER 30, 1965 THRU MARCH 29, 1966

CONTRACT NAS8-20240

PREPARED FOR
MARSHALL SPACE FLIGHT CENTER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
HUNTSVILLE, ALABAMA

THE BOEING COMPANY
HUNTSVILLE, ALABAMA

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## 1.0 INTRODUCTION

On June 29, 1965, The Boeing Company was awarded Contract NAS8-20240 for the "Advanced Systems Checkout Design" study. This study is to determine what checkout functions can and should be performed on-board the Saturn Instrument Unit and S-IVB stages, how these functions would be mechanized, the impact of these changes on the presently planned Saturn V GSE and schedules, and to develop design guidelines or requirements for incorporating the on-board checkout features.

The concept of Airborne Evaluation Equipment (AEE) is centered on the use of on-board stage equipment for evaluation of stage status. This concept provides a high degree of stage autonomy as regards testing, providing consistent results through all phases of test and reducing the requirement for support equipment.

## 1.1 SCOPE OF STUDY

The present checkout method for the Saturn vehicle utilizes extensive support equipment to determine vehicle condition, with access through numerous umbilical connections. The equipment being used varies in type and configuration between the various test locations making test data correlation difficult. With the emergence of this vehicle from a developmental status, the test requirements can be more firmly established and the need for acquiring engineering data reduced. With the advances being made in electronics packaging density, size, and power consumption, it is feasible to perform this new scope of testing with a large share of the evaluation equipment located on the vehicle proper. This would also provide relief in correlation of test results between test sites since the test equipment would travel with the vehicle. It would also be available during the mission to perform an in-flight checkout.

This concept places new emphasis on the interface between the vehicle and support equipment. With an on-board checkout system, the bulk of the data reduction and evaluation can occur on the stages under the overall supervisory control of the support complex computer, with status and maintenance information sent to the ground by a data link.

The introduction of this concept will drastically reduce the number of umbilical interconnects and quantity of support equipment, making it easier and less costly to accommodate varying configurations of vehicles at checkout complexes.

The implementation of the AEE concept may well be accomplished in degrees, that is, the first step being the placement of the function satisfying equipment, in a miniaturized form, on the stage and the second step being where the stage subsystem is re-designed to incorporate the function.

## 1.2 STUDY ORGANIZATION

This study, in accord with the work statement, is divided into two phases. Phase A consists of a ten month effort to develop requirements, configuration, and impact of the AEE concept and Phase B, a three month effort to generate the guidelines for its incorporation into a space vehicle system.

## 2.0 PROGRESS AND ANTICIPATED WORK

The first three quarters of this study represent nine of the ten months allocated to Phase A, Phase A being the determination of the what and how of implementing evaluation equipment on-board the S-IVB and Instrument Unit. The first two quarters were devoted to the accumulation and review of documentation relating to stage configuration, test procedures and utilization of umbilicals and DDAS for checkout. The third quarter has been devoted to establishing a configuration for the on-board equipment, expanding on Instrument Unit test requirements with the assistance of Quality and Reliability Assurance test engineers and documentation of the first three quarters effort.

Boeing document D5-13257, "Requirements and Implementation - Airborne Evaluation Equipment", has been produced which includes the following:

a. Introduction - Review of the statement of work and approach to the study.

b. Saturn S-IVB and Instrument Unit Test Requirements/Test Equipment Requirements - Summary of test requirements, emergency requirements, test conductor role and software requirements - sufficient to size out the test system.

c. Approaches to Test Equipment Implementation - Discussion of the various approaches (centralized versus de-centralized) and some of the trades requiring consideration.

d. Function Satisfying Test Equipment Configuration - A detailed description of the equipment required on-board that satisfies, initially, the AEE requirement.

e. Advanced Hardware and Test Techniques - Discussion of improved instrumentation or test techniques that could be implemented in the future.

Appendices

a. List of Documentation Utilized In the Study

b. Umbilical Data Sheets, showing disposition of each umbilical

c. S-IVB/IU Checkout Model - detailed configuration and requirements

The configuration established above represents a minor re-design to the stage and in essence is a "miniaturized GSE" configuration. This permits utilization of current test methods and procedures, and permits expansion for advanced techniques. The ultimate configuration of AEE, for which guidelines will be generated during Phase B, would have some functions located in the stage subsystems.

The next month's activity, which is the last month of Phase A, will be concerned with a phase-in plan, GSE impact, cost and effectiveness, and physical characteristics of the system. In addition, the ultimate configuration will be defined for the Phase A presentation.

## 3.0 SCHEDULING AND MANNING

A chart containing this information is shown in Figure 1.

## 4.0 PROBLEMS

None

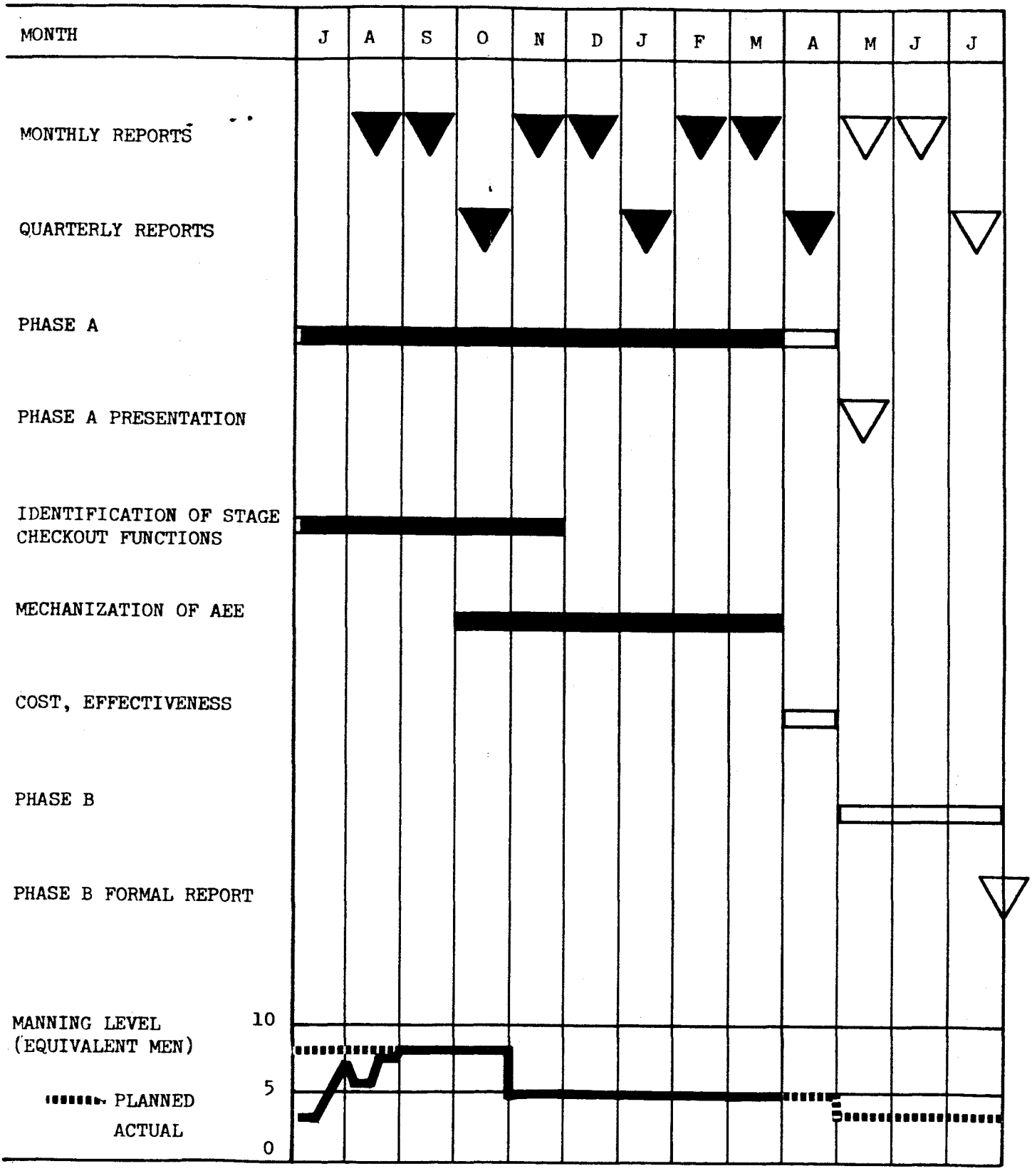


FIGURE 1
PROGRAM SCHEDULE AND MANPOWER EXPENDITURE